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A Journal of Scottish Natural History

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THE SCOTTISH NATURALIST

A Journal of Scottish Natural History

With which is incorporated *The Annals of Scottish Natural History* and *The Western Naturalist*

99th Year 1987

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THE SCOTTISH NATURAL HISTORY LIBRARY

THE FLORA OF BERNERAY, MINGULAY AND PABBAY, OUTER HEBRIDES, IN 1964

By A.S. CHEKE
Oxford

and T.M. REED
Nature Conservancy Council

Introduction

In spite of the number of expeditions to the southern islands of the Outer Hebrides within recent years, by Diamond, Douthwaite and Indge (1965) in June 1964, Child (1964) in August 1964, Mawby (1964) in August 1964, Huxham (1967) in September 1967, Williams (1976) in August 1971, Dobbs (1975) in July 1975, Deeley (1975a,1975b) in July/August 1975, Braund (1979) in May 1979, and the R.A.F. Ornithological Society (1979) in June/July 1979, almost nothing has been published on the botany of Berneray, Pabbay and Mingulay since the visits of Clark (1938) in 1937 and Heslop-Harrison (1941) (see Currie 1979). Since these visits the flora of the islands has undergone change, more particularly amongst the plants of formerly cultivated areas.

In June 1964 an expedition from Cambridge University (Diamond *et al.* 1965) visited all three islands, whilst Child (1964) and Mawby (1964) visited only Mingulay. Although mainly an ornithological expedition, two members of the Cambridge expedition studied the flora on all three islands; A.S.C. recorded the vascular plants and A.C. Hamilton the bryophytes. Only vascular plants are dealt with here.

Unlike the bird survey (Diamond *et al.* 1965), the results of the 1964 botanical investigations, although considered, were never submitted for publication, and the original manuscript has only recently been examined by T.M.R. It was felt that the results certainly merited being placed on permanent record, even although the investigations took place over twenty years ago. This paper therefore gives details of the flora of each of the islands (by A.S.C.), along with notes of species status on subsequent expeditions, and a brief comparison with the floras of some other islands in the British Isles with similar histories (by T.M.R.).

The history, geography and general vegetation of Berneray and Mingulay have been described by Clark (1938). In 1964 the islands were much the same as they were in the 1930s; the

Berneray
landing place
old village
100
The Aird
152
Nisam Point
Mullach Rosnish
Cuiveg Point
100
200
300
400
500
600
road
Mullach a' Lochain
Sotan
Skate Head
Pun brisle 300
Barra Head
0
mile
1/2
contours in feet

lighthouse on Berneray was still manned and Mingulay had been uninhabited for a further 27 years, making 50 years altogether since the village had moved to the island of Vatersay. The gamekeeper and two shepherds who lived there in 1937 left during the war. In 1964 all three islands were used for sheep grazing by the Barra Sheepstock Holding Company, and were, and are, periodically visited for shearing, dipping, and collecting lambs for sale. There were Rabbits *Oryctolagus cuniculus* on Mingulay and Berneray, but not on Pabbay. Heslop-Harrison (1939,1941) gave Pabbay somewhat inadequate treatment in papers in which several other islands, including Barra, were covered.

Only the more conspicuous and abundant Gramineae were identified in addition to the rest of flora, which was identified on the spot using Clapham, Tutin and Warburg (1962).

Vegetational Analysis of the Islands

BERNERAY

Berneray is the smallest and most southerly of the three islands, and is composed of Lewisian Gneiss, which forms cliffs rising to 628 feet (190m) at the west end. The cliffs on the south side of the island are high along most of the coast, and taper slowly into a rocky shore in the east. Along the northern coast the cliffs are low, and are almost absent east of the old village. Inland the ground rises from the east to the Barrahead cliffs in the west. There is a small amount of boulder clay, which is exposed along parts of the north coast as eroding sandy cliffs.

The vegetation of Berneray is the simplest and least varied of the group, and may be divided into three major zones, two of which intergrade. Unlike Mingulay, the moorland and areas of old cultivation running east to west across the island lack a defined boundary. Along the southern cliffs the moor is separated from the cliff zone by a sheep fence. The moorland which covered most of the island was dominated by *Molinia caerulea* and *Carex echinata; Salix repens* was very common, forming a carpet in some areas. *Eriophorum angustifolium*, *Eleocharis multicaulis* and *Juncus effusus* were common in the numerous damp patches. There are no real streams on the island, apart from a ditch running down beside the road, but the moors were dotted with wet flushes holding *Sphagnum* associations, including *Drosera rotundifolia*, *Narthecium ossifragum*, *Pinguicula vulgaris* and *Viola palustris*. Rock outcrops in the moors were often fringed by *Sedum anglicum* and *Thymus drucei*. Throughout the moorland area *Anagallis tenella*, *Pedicularis sylvatica* and *Potentilla erecta* were abundant; *Dactylorhiza*

ericetorum was widespread. *Primula vulgaris* and *Blechnum spicant* were conspicuous on banks and sheltered places. The remarkably scarcity of *Calluna vulgaris* was commented on by Clark (1938). Small short-term pools were a feature of the south-east of the island, and *Littorella uniflora* and *Eleocharis multicaulis* were common in these. The short streamlets leading out of the flushes often held *Potamogeton* spp. and *Montia fontana*; deeper pools had *Callitriche stagnalis*.

The old grazed and arable areas on the northern slope of the island were dominated by *Festuca ovina*, with an admixture of other grasses. Some areas of old arable land were dominated by *Potentilla anserina*, almost to the exclusion of anything else. Throughout the grassland *Scilla verna*, *Polygala vulgaris*, *P. serpyllifolia*, *Succisa pratensis* and *Carex nigra* were common. Wet areas on the slope held *Triglochin palustris* and *Hydrocotyle vulgaris*; marshy patches nearer sea-level contained *Iris pseudacorus*, *Lychnis flos-cuculi*, *Filipendula ulmaria* and *Senecio aquaticus*. Two plants of *Dactylorhiza majalis* still survived in the marsh by the landing place, and the leaves of another species (possibly *D. purpurella*) were found. *Carex ovalis* was very common along ditches and in the marsh by the landing place; it was not found on the other islands. *Echium vulgare* was recorded in August 1964 (Mawby 1964).

The weed flora associated with the old village is more fully discussed later.

The third zone was the cliff zone. Soil just inland of exposed rocks on the cliff was usually covered with dense patches of *Armeria maritima* and stunted, close-growing, *Plantago maritima*. *P. coronopus* and *Sagina procumbens* were also common there. The high cliffs in the south supported large breeding colonies of seabirds, mostly auks Alcidae. Their droppings greatly enhanced the otherwise nutrient-poor status of the sparse rock debris soil on the ledges. Here there were luxuriant growths of *A. maritima*, *Silene maritima*, *Tripleurospermum maritimum* and *Rumex crispus*. The height of the latter two meant that, in some areas, Puffins *Fratercula arctica* standing at the entrance to their holes were almost hidden. All round the island crevices in the cliffs provided a habitat for *Asplenium marinum*, *Lingusticum scoticum*, *Angelica sylvestris* and *Sedum rosea*. Clark (1938) found *Silene acaulis* to be not uncommon near the lighthouse, but the 1964 expedition failed to find any. *Cerastium atrovirens*, not recorded by Clark, was common on high ground everywhere, especially on cliff edges.

There is a small round stone burial mound, 12 feet across (3.70m) and six feet (1.80m) high, beside the road close to the lighthouse gates. In it was a cultivated form of *Gladiolus*, and also *Ranunculus ficaria*, likewise probably planted.

MINGULAY

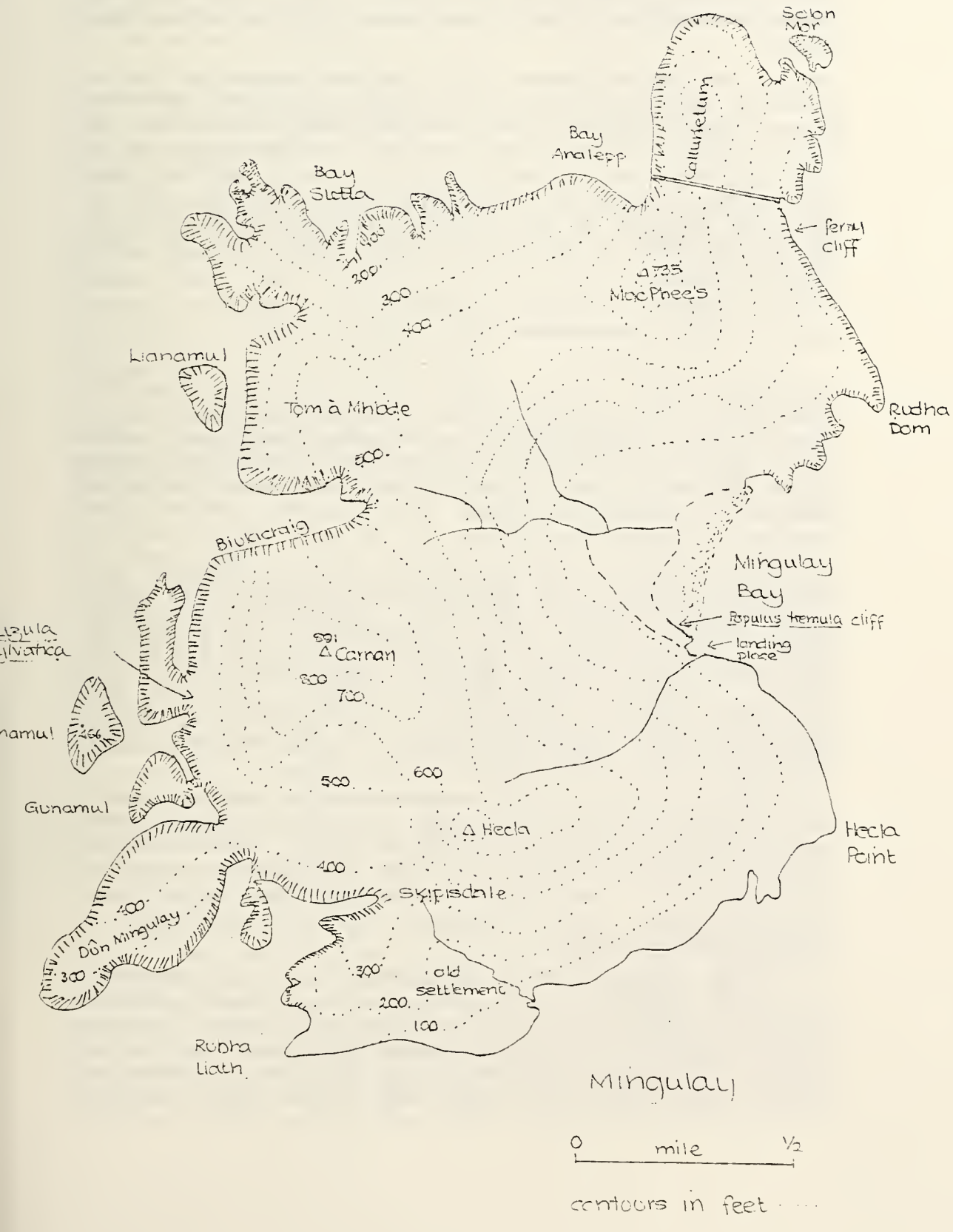
Mingulay is dominated by two hills, Carnan (891ft; 270m) and MacPhee's (735ft; 304m) and the ridge that joins them, running south-west to north-east. To the south-east of Carnan is a third hill, Hecla (700ft; 212m). To the north-west of Carnan is the second highest seacliff in Scotland, which drops 735 feet (228m) into the sea. The whole of the west of the island consists of high cliffs, which give way to a low rocky shore in the south, but continue round the north end and down the east nearly to the bay. The centre of the east coast consists of a long sandy beach, inland of which are sand dunes, the remains of the old village, and the sheltered valley which was formerly heavily cultivated. Like Berneray, Mingulay also consists of Lewisian Gneiss. In addition, boulder clay deposits in the valley reach 15-20ft (5-6.5m) in thickness at the south side of the bay.

Most of the island consisted of the same very poor moorland as on Berneray, but there were also several additional habitats. The various vegetation types influenced by the dunes in the bay were the most striking of these. Inland of the beach were unstable dunes being colonized by *Ammophila arenaria* and *Eryngium maritimum*. Further inland towards the chapel the sand was slowly advancing over former cultivated areas, and these had a flora that was growing up through the accreting sand. Nearest the beach, *Sedum anglicum*, *Erodium cicutarium* and *Galium verum* were common, and still dominant in 1979 (Braund 1979) but gave way inland to close rabbit-cropped *Festuca ovina* grassland in which *Selaginella selaginoides* formed a kind of under-storey. *Ophioglossum vulgatum*, *Stellaria media*, *Euphrasia* spp., *Polygala vulgaris*, *Veronica arvensis* and *Prunella vulgaris* were common. By 1979 *Polygala serpyllifolia* had increased at the expense of *P. vulgaris* (Braund 1979), but the *Prunella* (in two colours) was still common (R.A.F.O.S. 1979). Inland of this area was a grassy slope covered with *Pteridium aquilinum*; *P. aquilinum* had also spread up the slope to the north of the bay. The short turf around the chapel and in the drier fields nearby was very like that lower down, but lacked *Ophioglossum*, gaining *Trifolium repens* and *Polygala serpyllifolia*. In spring 1979 *Ranunculus ficaria* was common in this area (Braund 1979).

Slightly to the south lay the main part of the ruined

village, into which sand was also encroaching. Rabbits were contributing to the destruction of buildings and stone walls by undermining; the graveyard where Clark described standing crosses and gravestones had become a warren, with the bones of the former inhabitants liberally scattered. The flora of this area, in which *Urtica dioica* and the two thistles *Cirsium arvense* and *C. vulgare* predominated, is more fully discussed later. By 1979 *Geranium columbinum*, *Erodium cicutarium*, *Lotus corniculatus* and *Potentilla anserina* had spread into this area (R.A.F.O.S. 1979). The marshlands near the old village were more extensive, containing a richer flora than on Berneray. They were fed by three streams running down from the ridge joining Carnan and MacPhee's. Two of these joined just before reaching the beach. The most southerly of the streams had carved a sheltered gorge in which grew *Lonicera periclymenum* and *Osmunda regalis*, before draining into the sea near the landing place. Here in a small marsh *Hypericum pulchrum*, *Lycopus europaeus* and *Epilobium palustre* were found; all were still present in 1975 (Dobbs 1975). Although frequent on Berneray, *Cardamine pratensis* was confined to this marsh and was still found there in 1979 (Braund 1979) along with *Cochlearia officinalis*. The other two streams drained into the village, cutting down through the sand as they passed through it. The sandy banks were favoured by *Equisetum arvense* and *Tussilago farfara*. *Caltha palustris* and *Iris pseudacorus* lined the sides of the streams. The northermost stream, as it passed the chapel, supported some stunted *Phragmites communis*, among which grew *Epilobium palustre*, *E. parviflorum* and *Oenanthe crocata*.

Also in the valley was a microcosm of what was probably the most interesting community on the islands. On a sheltered boulder clay cliff (the 'Aspen cliff') at the southern end of the bay, facing the sea, grew several plants of Aspen *Populus tremula*, semi-prostrate and never more than two feet (0.6m) high. Among these straggled Ivy *Hedera helix*. By 1979 the Ivy had vanished, although there was still some Aspen (Braund 1979). Two or three plants of a *Rosa*, called 'glaucophylla' by Clark, were also there; Braund (1979) identified these as *R. rubiginosa*. Several other species were confined to this cliff: *Succisa pratensis*, *Hieracium anglicum* and *Taraxacum officinale*. *Thalictrum minus* was much commoner here than elsewhere. Clark (1938) suggested that this area contained what remained of a former woodland association, and his find of *Equisetum sylvaticum* there, now vanished, tends to confirm this view. If there was such a community it is strange that a *Betula* or *Pinus sylvestris* was not the tree species to survive; nevertheless the presence of both Ivy and Aspen is symptomatic of a more


Selon Mor
Bay Analepp
Bay Slotta
Callunetum
fern cliff
MacPhee's
Lianamul
Tom à Mhàdie
Rudha Dom
Biukicraig
Mingulay Bay
Populus tremula cliff
landing place
Carran
Hecla
Hecla Point
Gunamul
Skipisdale
Dùn Mingulay
old settlement
Rubha Liath
Mingulay
0 mile ½
contours in feet

genial climate sometime in the past, even if they were the result of chance invasions. The Aspen, at least, is propagating itself successfully, since a large number of young suckers were found.

In the old settlement in the extreme south-east the few houses had broken walls 1 - 2 feet high still harbouring *Urtica dioica*. The fields had not been completely overrun by the *Molinia/Carex echinata* of the moorland. The remaining areas of old cultivation or enclosed grazing on the island were very like those on Berneray. In addition to *Dactylorhiza maculata* which was abundant in 1964, *D. fuchsii* was also found to be common over much of the island in 1975 (Dobbs 1975) and 1979 (Braund 1979).

The moorland differed from that of Berneray only in its extent, except in two areas.

In the south-west a fence ran from Dun Mingulay to Builacraig several yards inland of the cliff edge. Over the greater part of this ungrazed area *Luzula sylvatica*, apparently absent in 1979 (Braund 1979), was dominant and would spread over a much larger area if not kept down by the sheep grazing inside the fence. *Vaccinium vitis-idaea* was common here and on MacPhees's in 1979 (R.A.F.O.S. 1979), and *V. oxycoccus* was recorded in 1964 (Mawby 1964).

The scarcity of *Calluna vulgaris* on the moorland has been mentioned before, and this applies equally to most of Mingulay. At the extreme north of the island, however, undiscovered by Clark, there were some 25 acres (10 ha) of pure Callunetum, interrupted only by sheep hollows around which grew *Blechnum spicant*, *Dryopteris dilatata* and *Senecio jacobaea*. The Callunetum was still present in 1975 (Dobbs 1975). The reason for this distinct type of vegetation on just one part of the moorland was not at all clear.

On Dun Mingulay, the flat promontary in the south-west, the presence of a gull *Larus* spp. colony provided conditions normally found only on the adjacent cliffs. *Rumex crispus*, *Tripleurospermum maritimum* and *Silene maritima* were abundant and *Chenopodium album*, lost as a weed in the village, grew between the gulls' nests. Sheep had no access to Dun Mingulay, nor were there any Rabbits.

In the north-east of the island there was a very sheltered cliff (the 'ferny cliff'), fed by a small stream. Ferns, elsewhere stunted and scarce, grew here in profusion, reaching heights of two feet (60cm) or more. *Athyrium filix-femina*, *Dryopteris dilatata*, *Blechnum spicant*, *Pteridium aquilinum* and *Osmunda regalis* were all common. *Salix aurita*, which was only

found here, was also frequent, as was *Lonicera periclymenum*, found otherwise, like *Osmunda*, only by the southernmost stream in the valley. *Solidago virgaurea* was confined to this cliff.

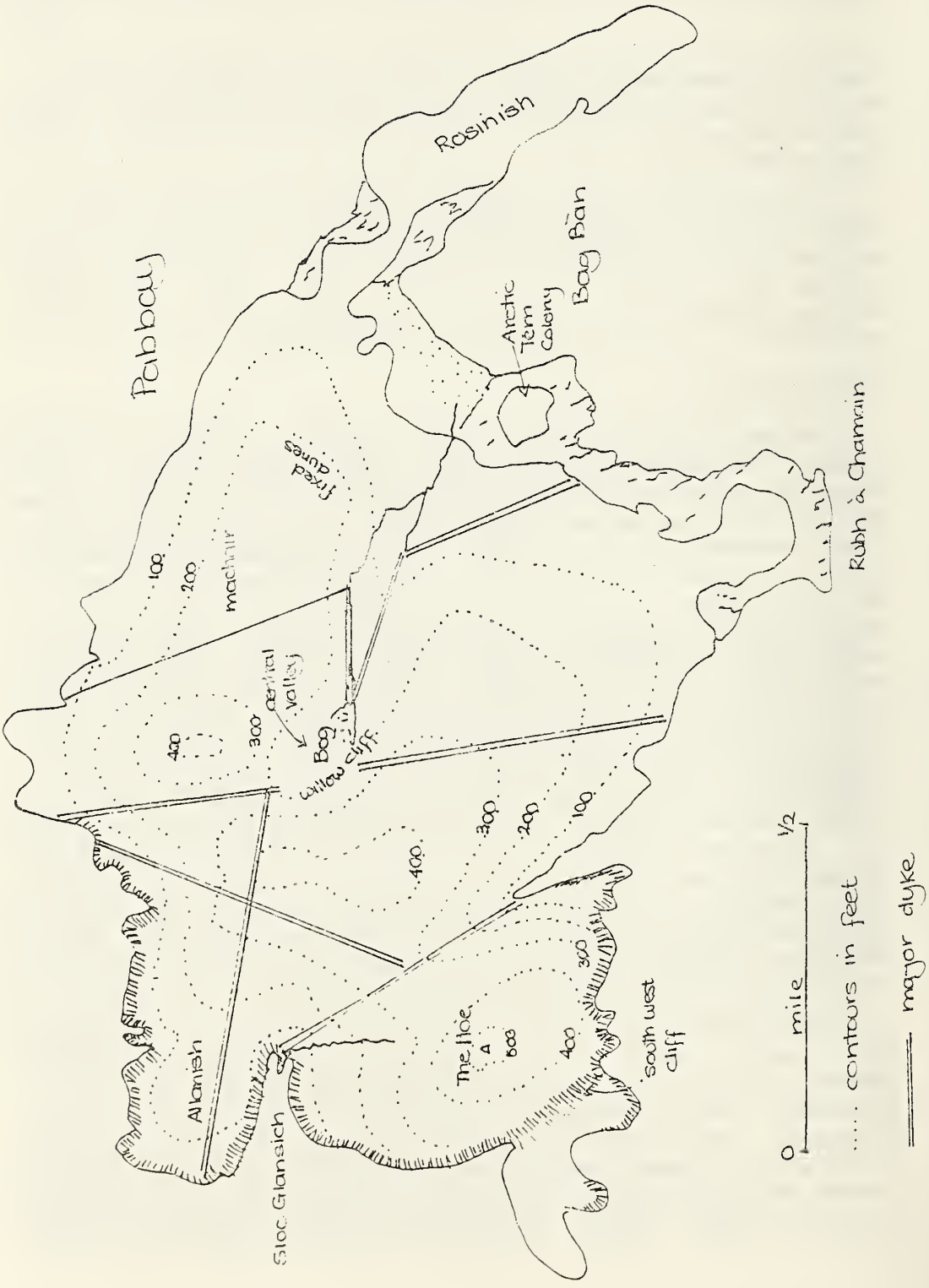
As on Berneray, *Silene acaulis* was absent; one of the party did find *Oxyria digyna*, Clark's other 'nunatak' species, but could not remember its exact location. Both species would now be interpreted as early post-glacial relics (Meldris 1953, Currie 1979).

Glaux maritima, the presence of which was commented on by Clark, was most abundant among the rocks of a large gull colony at the south end but also occurred where Clark found it, in another gull colony, at the top of a 100ft (33m) cliff in Bay Sletta. It may be that it needs high nutrient status as well as salt spray in order to grow outside saltmarshes.

PABBAY

Although much smaller than Mingulay, Pabbay is more varied. The highest point on the island (564ft; 171m) is just above the high cliff at the south-west of the island. Below this cliff is a raised beach, absent from the other islands. Cliffs extend along the west coast, diminishing northwards; these are seldom sheer and the raised beach persists for some way along them. In the south the cliffs come down rapidly to shore level, terminating in a large sweeping sandy bay, much larger than on Mingulay. Where the bay meets the north-east coast there is a low promontory, almost cut off from the main part of the island and inaccessible to sheep. Behind the beach is a large area of dunes. The old village is situated at the south-west end of the bay, inland of the dunes. Pabbay is crossed by a number of intrusive igneous dykes which have eroded away more rapidly than the surrounding gneiss, resulting in a series of channels with vertical sides cutting through the surface of the island. In the centre of the island several dykes intersect to form a large sheltered depression. In its centre there is a one acre (0.4ha) peat bog, the only one on the three islands. The bog is shallow and fairly eutrophic, being fed by streams running along the dykes.

Menyanthes trifoliata carpeted much of the bog, although there were areas of pure *Sphagnum*. *Pedicularis palustris* replaced *P. sylvatica* towards the centre of the bog. *Ranunculus flammula*, *Senecio aquaticus*, *Pinguicula lusitanica*, *Triglochin palustris*, *Carex echinata*, *C. panicea*, and *C. pulicaris* were particularly common. Another striking feature of the central valley was its sheltered south-western wall with a dense growth of *Salix aurita* up to four feet (1.2m) high (the 'Willow cliff'). *Vicia sepium*, *Pteridium aquilinum* and *Dryopteris*


Rasinish
Bag Bàn
Arctic Tern Colony
Rubh à Chamain
Pabbay
fixed dunes
machair
100
200
300
400
central valley
Bog
Yellow Cliff
Allanish
Sloc Glamaich
The Hoe
South West Cliff
0
mile
½
..... contours in feet
major dyke

dilatata were both common on, and confined to, this area. *Lonicera periclymenum* and *Filipendula ulmaria* were luxuriant.

The south-western cliffs differ from the big cliffs on the other two islands in lacking seabirds. This was almost certainly due to their being fringed by a raised beach. The lack of bird droppings and sea-spray had produced a distinctive cliff flora. *Sedum rosea*, *Silene maritima* and *Angelica sylvestris* were as common as elsewhere, but *Tripleurospermum maritimum* was a little scarcer, and *Rumex crispus*, *Asplenium marinum* and *Ligusticum scoticum* a lot scarcer, than on equivalent cliffs on Berneray and Mingulay. *Juniperus communis* and a *Rosa* were growing on the cliff, the former being plentiful.

Immediately above the cliff, around the triangulation point, was the most exposed area found on any of the three islands; this was reflected in the vegetation. There was very little ground cover, much of the area being exposed rock with peaty pools full of *Littorella uniflora*. The only common land plant was *Juniperus communis* ssp. *nana*, which locally formed extensive mats. The local abundance of this species is interesting, given its absence from the other islands.

The remainder of the moorland was similar to that on the other islands, but was characterised by *Erica cinerea*, elsewhere absent. Both *E. cinerea* and *E. tetralix*, and *Calluna vulgaris*, were particularly common along the edges of the gullies formed by the dykes. These were also favoured by *Lonicera periclymenum* and *Athyrium filix-femina*. *Erica cinerea* also occurred over the open moorland with *E. tetralix*.

The abundance of *Pinguicula lusitanica* on parts of Pabbay, compared with its apparent scarcity on the other islands, was perhaps due to its flowering time. *P. lusitanica* flowers when *P. vulgaris* has nearly finished; prior to this both species are difficult to distinguish by leaves alone. *P. lusitanica* became more 'common' during the expedition's stay on Pabbay as more plants came into flower. There were very few surviving flowers of *P. vulgaris*, whereas they had been common on the other islands during the previous two weeks. The more sheltered situations available on Pabbay may also favour *P. lusitanica*.

The flora of the old fields and the marsh near the old village was very similar to that of comparable areas on Mingulay. The marsh had a thriving little *Phragmites* reed-bed. Several plants of a cultivated mint (*Mentha*) were also there, growing with *M. aquatica* and many other species also found on the other islands.

Pabbay had a far larger area of stable and semi-stable dunes than had Mingulay, and a well developed machair community. On the stable dunes, furthest from the sea, the dominant *Festuca ovina* was closely cropped by sheep. *Trifolium repens*, *Thymus drucei*, *Polygala serpyllifolia* and *Prunella vulgaris* were also common. On the younger dunes *Ammophila arenaria* persisted, with other grasses and many other plants typical of machair; some of these were rare or absent on Mingulay but were common here: e.g. *Anthyllis vulneraria*, *Rhinanthus minor*, *Daucus carota*, *Heracleum sphondylium* and *Centaurium erythraea*. The unstable dunes were colonized by *Ammophila arenaria* and *Eryngium maritimum*. *Chenopodium album* was found on bare sand on the beach. Where the two streams from the central valley had cut through the dunes, the banks were covered with *Tussilago farfara* and *Equisetum arvense*, and along the water's edge were *Carex otrubae* and *Scirpus maritimus*. A wet patch on the isolated dune holding an Arctic Tern *Sterna paradisaea* colony was full of *Juncus acutiflorus*.

The northern promontory on Pabbay, like Dun Mingulay, is inaccessible to sheep and had a gull colony. The vegetation was similar, with the addition of *Glaux maritima*.

When one compares the relative abundance of pairs of similar species which live in similar localities, there can be very marked differences among the three islands. For any given pair, one species may be more common on one island, less common on another island, or both species may be equally common (see Table 1).

The Flora of Old Cultivated Land and Villages

Clark (1938) listed 53 species, 31 of which were confined to Mingulay, which could be considered to be either weeds of cultivation or plants connected in some way with human occupation of the islands. Many of these records were confined to only one or two plants in a single locality. In the quarter century between Clark's visit and the 1964 survey there was a very considerable net decrease on both Mingulay and Berneray (see Tables 2 and 3).

Clark pointed out that Mingulay had more weed species for two reasons: (1) Mingulay had been inhabited more recently; many of the weeds Clark recorded were found only in the garden of the house where the gamekeeper then still lived. The lighthouse area on Berneray did not seem to provide any weeds. (2) Cultivation was more intensive over a much larger and more favourable area, i.e. the sheltered valley.

Between 1938 and 1964 both islands tended to lose the

Table 1

The relative abundance of closely related species on the islands in 1964

Species Pair	Species Commoner on:		
	BERNERAY	MINGULAY	PABBAY
Ranunculus acris/repens	*repens*	*acris*	*acris*
Polygala vulg./serpyll.	*vulgaris*	*vulgaris*	*serpyllifolia*
Trifolium pratense/repens	*pratense*	*repens*	both
Erica tetralix/cinerea	*tetralix*	*tetralix*	both
Myosotis arv./versicolor	-	*versicolor*	*arvensis*
Rumex acetosa/ac'lla	both	*acetosella*	*acetosa*
Carex nigra/flacca	*nigra*	*flacca*	*

* the absence of both *Carex nigra* and *C. flacca* (and *Schoenus nigricans*) is surprising

Table 2

(a) Number of Weed Species, 1937 and 1964

	BERNERAY	MINGULAY	PABBAY
1937	23	53	
1964	13	31	23

(b) Changes in Weed Species, 1937 to 1964

	BERNERAY	MINGULAY
Lost	10	24
Decreased	1	5
Same	11	17
Increased	1	7
New	-	2

tall-herb element of the weed flora. *Daucus carota*, *Heracleum sphondylium*, and *Sonchus oleraceus* had vanished, as had *Cirsium arvense* on Berneray. *Sinapis arvensis*, *Anthriscus sylvestris*, *Artemisia vulgaris* and *Rumex obtusifolius* never were on Berneray and had disappeared from Mingulay. This may have been due to loss of shelter as buildings deteriorated, or to a climatic change. *Arctium* sp. and *Sonchus asper*, which had actually increased on Mingulay, were confined to the shelter of old buildings in the ruined village. There was much less shelter from buildings on Berneray since the ruins were in a far worse state.

On Mingulay a significant proportion of the change was due to small annuals, the loss of typical garden weeds such as *Senecio vulgaris*, *Fumaria officinalis*, *Capsella bursa-pastoris* and *Veronica persica*. Only one of these, *Capsella*, had been recorded on Berneray in 1937. The continued reduction of disturbed ground with grassland encroachment may have led to the decline of small annuals, but one would have expected this to be offset by bare soil continuously exposed by Rabbits in the village. Some species in this category had disappeared as ruderals but remained in natural habitats, for example *Tripleurospermum maritimum* and *Chenopodium album*; neither occurred any longer in the village. *Senecio jacobaea* was common in sheltered parts of the north end of the island, but only one plant was found in the village.

Of the remaining species, several were not purely weeds, but were plants which also commonly occupied niches in more or less natural habitats. The Nettle *Urtica dioica* thrived in the vicinity of old buildings and Rabbit warrens on Mingulay, but had survived in only one patch on Berneray; its relative *U. urens* had disappeared from Mingulay. All nettles were stunted, their height depending on the amount of shelter they had. *Bellis perennis*, *Taraxacum laevigatum*, *Trifolium pratense*, *T. repens*, *Ranunculus acris* and *R. repens* are all species often associated with the presence of Man but can survive without him especially if long grass is grazed by sheep or Rabbits. The two Sorrels *Rumex acetosa* and *acetosella* are similar; *R. alpinus* appeared in 1979 (R.A.F.O.S. 1979). *Trifolium pratense*, however, had decreased on Mingulay, while *Ranunculus acris* appeared to have spread into the old cultivated areas from the cliffs. *R. repens* was the commoner of the two Buttercups on Berneray, whereas this species was relatively scarce on Mingulay. In some fields on both Berneray and Mingulay *Potentilla anserina* still formed the nearly pure associations mentioned by Clark.

Three species had increased strikingly on Mingulay:

Table 3

Changes of Status in Weed Species 1937-1964

BERNERAY	MINGULAY
Lost:	
Capsella bursa-pastoris	*Ranunculus bulbosus*
Vicia cracca	*Fumaria officinalis*
Heracleum sphondylium	*Sinapis arvensis*
Daucus carota	*Capsella bursa-pastoris*
Cirsium arvense	*Arenaria serpyllifolia*
Centaurea nigra	*Spergula arvensis*
Sonchus oleraceus	*Anthriscus sylvestris*
S. asper	*Heracleum sphondylium*
Odontites verna	*Daucus carota*
Plantago major	*Matricaria suaveolens*
	Tripleurospermum maritimum
	Artemisia vulgaris
	Senecio vulgaris
	Sonchus oleraceus
	Veronica persica
	Odontites verna
	Rhinanthus minor
	Mentha arvensis
	Galeopsis tetrahit
	Chenopodium album
	Polygonum aviculare
	P. persicaria
	Rumex obtusifolius
	Urtica urens
Decreased:	
Urtica dioca	*Trifolium pratense*
	Vicia cracca
	Senecio jacobaea
	Anagallis arvensis
	Plantago major

Table 3 (continued)

Changes of Status in Weed Species 1937-1964

BERNERAY	MINGULAY
No Change:	
Ranunculus acris	*Ranunculus repens*
Cerastium holosteoides	*Cerastium holosteoides*
Stellaria media	*Stellaria media*
Trifolium pratense	*Potentilla anserina*
T. repens	*Bellis perennis*
Potentilla anserina	*Cirsium vulgare*
Bellis perennis	*C. arvense*
Cirsium vulgare	*Centaurea nigra*
Taraxacum laevigatum	*Taraxacum laevigatum*
Rumex acetosa	*Sonchus arvensis*
R. acetosella	*Lycopsis arvensis*
	Myosotis arvensis
	Veronica arvensis
	Lamium cf. *hybridum*
	Urtica dioica
	Rumex acetosa
	R. acetosella
Increased:	
Ranunculus repens	*Ranunculus acris*
	Geranium molle
	Trifolium repens
	Galium aparine
	Arctium sp.
	Sonchus asper
	Myosotis versicolor
New (reported since 1964):	
Rumex alpinus	*Sedum acre*
	Taraxacum officinale

Table 3 (continued)

Changes of Status in Weed Species 1937-1964

Weeds recorded on Pabbay:

Ranunculus acris
R. repens
Cerastium holosteoides
Stellaria media
Geranium molle
Trifolium pratense
Heracleum sphondylium
Daucus carota
Sedum acre
Galium aparine
Bellis perennis
Senecio jacobaea
Arctium sp.
Cirsium vulgare
C. arvense
Taraxacum laevigatum
Sonchus asper
S. arvensis
Myosotis arvensis
Veronica arvensis
Urtica dioica
Rumex acetosa
Chenopodium album
Rhinanthus minor

Arctium sp., *Galium aparine* and *Geranium molle*. The *Arctium* was all too young to identify. It may have spread from the one plant reported by Clark, or may perhaps have been brought in by sheep-shearers, attached to their clothing. This may also apply to *Galium aparine*, which also has fruits which attach themselves to clothing; Clark found only one plant. Both species were confined to the ruined buildings in the village. *Geranium molle* was different; the spread of the dune sand into the village area seems to have helped this species, and it was common throughout the village.

There were only two additions to the ruderal flora, both on Mingulay. One plant of *Taraxacum officinale* was found on the *Populus tremula* cliff at the south end of the bay. This may not have been introduced by Man, although it is quite near the landing place. *Sedum acre* is included because it was only found in man-made habitats: a few plants on a sandy field near the chapel on Mingulay, and all over the one standing house on Pabbay. The two plants of *Solanum tuberosum*, growing near the one house still with walls on Berneray, were unlikely to have been left over from the old cultivation (the best Potatoes in the Barra islands are said to have been grown on Mingulay). The lighthouse-keepers or previous expeditions were the probable source.

The information on weeds from Pabbay is rather difficult to abstract from Heslop-Harrison's composite paper (1941), but the situation appears to be intermediate between Mingulay and Berneray (see Table 3). *Daucus carota* and *Heracleum sphondylium* had survived in the machair. *Trifolium pratense* was still common. Otherwise the plants were much as on Mingulay although there were fewer small annuals: *Anagallis arvensis*, *Lycopsis arvensis*, *Myosotis versicolor* and *Plantago major* were absent.

The picture of change in weed species is very similar to that observed on the Blaskets in Ireland and on St. Kilda subsequent to their depopulation (Reed 1978). On both island groups, man-associated weed species were amongst the first species to be lost from the islands, along with bird species and rodents associated with the crofting community.

Surprisingly few species appear to have been lost subsequent to 1964 (Braund 1979), perhaps due in part to the continued high population of Rabbits providing suitable open habitats around their warrens.

Systematic List

The following systematic list differs from Clark's (1938) list in several respects. Clark's ommission of *Narthecium ossifragum* and *Thymus drucei*, two of the commonest plants on the islands, must have been due to accidental oversight in the writing-up; Heslop-Harrison (1941) referred to them as common on all the islands. Conversely, Clark's record of *Equisetum palustre* was probably a misidentification for *E. arvense*, which we found to be common on Mingulay.

We differ also over the distribution of many *Carex* species. In the absence of specimens it is difficult to prove our case, but a great deal of time was spent on the islands trying to find and identify *Carex* species, especially those which Clark recorded. Clark's omission of the conspicuous and common *C. panicea* is odd, whereas we failed to find his 'common' *C. serotina*, although we found *C. demissa*, a segregate from it, in quite different habitats. The flowering time of these sedges, as in the case of the *Pinguiculas* mentioned in the discussion of Pabbay, may be the key to some of the confusion; Clark did not say in which month he was there, but it must have been about a month earlier in the year than the 1964 expedition's visit.

Observations by Braund (1979) have been included in brackets where they denote a change from Mingulay in

BERNERAY

Berneray has been ommitted from the systematic list; the flora had changed little between 1937 and 1964. The only plants of interest not mentioned in the main discussion of the island were as undernoted:

Galium saxatile: Thinly spread on the moorland; not recorded by Clark.

Leontodon autumnalis: Rare on cliff tops in the south; not recorded by Clark.

Luzula sylvatica: Collected, but locality not recorded; not recorded by Clark.

Juncus acutiflorus: Clark had *J. articulatus*, which we did not find.

Athyrium filix-femina: Infrequent in sheltered hollows on the north side; not recorded by Clark.

SPECIES	MINGULAY 1937	MINGULAY 1964	PABBAY 1964
Thalictrum minus	Common on the dunes and sandy cliffs of the Bay	No change	Common on sandy areas around the bay
Ranunculus flammula	Of general occurrence in wet areas	Very common in wet areas	Common, especially in the bog
Ranunculus acris	Confined to the cliffs	Has spread to lower areas and is common in the valley	Commoner than *R. repens*, mostly in the village
Ranunculus repens	Uncommon; a weed of cultivation	Rare in the valley	Fairly common in the village area
Ranunculus bulbosus	Only on the dunes and sandy places	-	Fairly common in the village area
Ranunculus ficaria	A few plants on a rock ledge at the south of the Bay	Still present; (common in 1979)	Only in a little sandy gorge made by the eastern-most stream in the village
Caltha palustris	Sparingly in wet places and old fields	Now common along the two north streams in the valley	Common by the streams in the village
Fumaria officinalis	Weed of cultivation in the keeper's garden	-	-
Cardamine pratensis	Very rare; only in the marsh by keeper's house	No sign of increase; (still confined to one location in 1979)	Common along the eastern stream in the village; not elsewhere
Cochlearia officinalis	Sparingly distributed on shores and cliffs	No change	- (? overlooked)

SPECIES	MINGULAY 1937	MINGULAY 1964	PABBAY 1964
Sinapis arvensis	On previously cultivated areas	-	-
Capsella bursa-pastoris	Waste ground	-	-
Viola palustris	Common in wet places and *Sphagnum* bogs	No change	Fairly common in wetter areas
Viola riviniana	Sheltered bank sides; not common	Very few plants found	Commoner than on Mingulay Not at south end
Polygala vulgaris	Common on the moors	Also in village area	Surprisingly uncommon
Polygala serpyllifolia	Fairly common on sandy cliffs (Incl: *P. dubia)*	Also in village area but rarer than *P. vulgaris;* expanding at expense of *P. vulgaris*	Much commoner than *P. vulgaris*, especially in village area
Silene maritima	Limited to and common on the north and west cliffs	No change	Not confined to any side, but only on the cliffs
Silene acaulis	Two or three clumps on the north slope of Hecla	-	-
Lychnis flos-cuculi	Fairly common in marshy places	No change	Common around the village but not present on the bog
Cerastium holosteoides	Common near old houses and on the cliffs	Common around village, but very scarce on sheltered cliffs	Common around the village and the adjacent dunes

Cerastium atrovirens	(Clark's cliff *Holostea* was probably this species)	Very common on the cliffs and on the mountains	-
Stellaria media	Old fields	No change	Quite common in the village area
Stellaria neglecta	Abundant in gullies on the western cliffs	Still there; also plants fitting this species in most respects in ruined houses in the village; ? large *S. media*	Similar plants were. found in the one standing house
Arenaria serpyllifolia	Rare on dry sandy banks near old houses in the Bay	-	-
Arenaria peploides	Only on the storm beach	-	-
Sagina procumbens	Cliffs and bare rocky places on the moors	No change	In similar places
Sagina subulata	West cliffs only. Much rarer than *S. procumbens*.	-	-
Spergula arvensis	Weed of cultivation in the keeper's garden	-	-
Montia fontana	Very common in the wet gullies on the cliffs at west and north	No change	Rather rare, except in one wet area on the west side
Hypericum pulchrum	Common on banks, stream-sides and sheltered places	Only found on the east side of the island, possibly because it is more sheltered	Quite common in the central valley and in the village

SPECIES	MINGULAY 1937	MINGULAY 1964	PABBAY 1964
Linum catharticum	Common enough on sandy cliffs in the west. (?)	All over the island	Fairly common throughout
Geranium molle	Colony of very few stunted plants in a sandy field near the chapel	Quite common throughout village area; (in 1979 *G. columbinum* was common nearby)	Present in a small quantity in the village
Erodium cicutarium	Found only on the dunes of the Bay	No change	-
Trifolium pratense	Quite common on grassy banks and old pastures	No longer common; a few plants in field near chapel	Quite common in the village and on the dunes
Trifolium repens	Thinly spread in old pastures	Now commoner than *T. pratense*; old fields	Commoner than *T. pratense* in the same areas.
Anthyllis vulneraria	Rare and local on cliffs and sandy places in east	Only a few plants were found; south end	Common on the dunes around the bay
Lotus corniculatus	Not uncommon on dunes and cliffs in the east	Common throughout the valley	Common in the central valley and around the bay
Vicia cracca	Uncommon; confined to old cultivated areas	Very rare in old fields in the valley	-
Vicia sepium	One plant only, in old field in the Bay	-	Very common on the 'Willow cliff' in central valley

Lathyrus pratensis	Sparingly on sandy cliffs and banks of streamlets	No change	-
Filipendula ulmaria	Common in marshy places	No change	In the village marsh and the 'Willow cliff'
Potentilla erecta	Universally distributed	The yellow flowers were very much a feature of all the islands	Universally distributed
Potentilla anserina	Abundant in old fields and waste places	No change; some almost pure fields	Similarly common in the vicinity of the village
Rosa spp.	'*R. glaucophylla*' (a) var. *typica*: 2 or 3 plants on the sandy cliffs, south end of the Bay (b) var. *reuteri;* one, as above	These plants were still present and had an interesting abnormality: flower buds were produced, but new green shoots grew from them and no blooms appeared. Some additional plants were found at the north end of the Bay. (*R. rubiginosa* found in 1979)	A few plants of a large-flowered white rose were growing on inaccessible ledges on the south cliff
Sedum rosea	Abundant on the cliffs	No change	Abundant on the cliffs
Sedum anglicum	Common on rocks near the sea, and on outcrops of gneiss on the moors	No change	Similarly distributed, but also common on the sand dunes
Sedum acre	-	Very rare, on a sandy patch near the chapel	The sole standing house was a mass of yellow

SPECIES	MINGULAY 1937	MINGULAY 1964	PABBAY 1964
Drosera rotundifolia	Common but local in boggy slacks in sheltered places	No change	Similarly distributed
Callitriche stagnalis	In peaty pools and streamlets	No change	Not recorded, but possibly overlooked
Epilobium palustre	Common and generally distributed	Rather sparse in wet places in the lower parts of the valley	Only by the streams in the village
Epilobium parviflorum	-	Several plants in and near the northernmost stream in the valley, below the chapel	As *E. palustre*
Hydrocotyle vulgaris	Common and widespread	No change	Less common than on Mingulay, but widespread
Eryngium maritimum	Abundant on the upper part of the beach	No longer abundant; but quite common. The plants all seemed very small, possibly due to a recent burial by sand of the most favoured area	Mostly on the north-west side of the bay amid Marram *Ammophila arenaria*
Oenanthe crocata	-	Quite common in the most northerly stream in the valley, especially in the village	-
Anthriscus sylvestris	Leaves of one plant in a sandy field	-	-

Ligusticum scoticum	Sparingly on the cliffs; plants very dwarf	Possibly increased; quite common on the cliffs	Less common than on cliffs of Berneray or Mingulay
Angelica sylvestris	Everywhere abundant, especially on the cliffs	No change	Very common
Heracleum sphondylium	Rare on the dunes and sandy cliffs	-	Very common on the dunes around the bay
Daucus carota	Mainly on sandy cliffs in the east	-	Also very common on the dunes
Hedera helix	Only observed on 'Aspen cliff'	No change (see text); (absent by 1979)	-
Lonicera periclymenum	Rare; confined to sides of sheltered banks	Very common on the 'ferny cliff' in the north-east, and also found along the southernmost stream in the valley	Common in sheltered areas in the north of the island, particularly in the central valley
Galium verum	Restricted to the dunes at the Bay	No change, but abundant within its area	Common on the dunes and around the village
Galium saxatile	Not common; only seen on the north side of Hecla, with *Juncus squarrosus*	Appeared to be quite common on the higher slopes of Hecla and Carnan	-
Galium aparine	One plant in an old field	Several plants in old houses in the village	Common among nettles in old houses in the village
Succisa pratensis	Common all over the island	Only found on the 'Aspen cliff'	In the sandy areas around the village

SPECIES	MINGULAY 1937	MINGULAY 1964	PABBAY 1964
Solidago virgaurea	Fairly common on sheltered banks	Only found on the ferny cliff in the north-east	Quite common in the central valley and sheltered areas
Bellis perennis	Common in old cultivated areas	No change	Similarly distributed
Antennaria dioica	Unexpectedly rare and local; confined to sheltered places in the east	No change	Widespread, but scarce on the moors in the east
Achillea millefolium	Common enough in sandy places	No change	Common on the dunes and in the village
Tripleurospermum maritimum	Var. *inodorum:* weed in the keeper's garden Var. *maritimum:* dominant on rocky ledges and cliffs in the west and north	Var. *inodorum:* - Var. *maritimum:* no change	Var. *maritimum:* only common on the south cliff
Matricaria suaveolens	Weed of waste ground by the keeper's house	-	-
Artemisia vulgaris	Also occurs on waste ground	-	-
Tussilago farfara	On the sandy banks of streams running into the Bay	Also in profusion on the sandy cliffs at the south of the Bay	Common by the two streams running into the Bay through the village
Senecio vulgaris	A weed in the keeper's garden	-	-

Senecio jacobaea	Restricted to the sandy cliffs at south end of the Bay	Not uncommon in sheltered parts of the north end. Only one plant found in the village	Fairly common in the village area
Senecio aquaticus	Much commoner than S. *jacobaea*; marshy places	Only in the marsh by the landing place	Common in the bog and in the marsh in the village
Arctium sp.	One plant, too young to identify; keeper's garden	Quite common in village, but nowhere old enough to identify	One plant in the only standing house
Cirsium vulgare	On the dunes at the Bay	Also in the sandier fields around the village	On sandy areas in the village, and the dunes
Cirsium arvense	Abundant in old fields	No change	Common in the village
Centaurea nigra	Not uncommon; old fields, banks and sandy cliffs	No change in distribution, but possibly not so common	Fairly frequent around the village and on sandy banks
Hieracium 'pilosella' or *H. anglicum*	Limited to one station on the east side	Common throughout the island!	Found commonly in the dyke running from the central valley to the village
Hieracium 'anglicum'	-	A few plants on the 'Aspen cliff' keyed out to this taxon	-
Leontodon autumnalis	Wet places on the moors	Apparently absent	Recorded, but location lost

SPECIES	MINGULAY 1937	MINGULAY 1964	PABBAY 1964
Taraxacum laevigatum	Old cultivated areas	No change	Common in the village and on the dune machair
Taraxacum officinale	-	One plant on the 'Aspen cliff'	-
Sonchus oleraceus	Weed of cultivation in old fields	-	-
Sonchus asper	Generally; on the cliffs	On the houses in the village	Also on houses
Sonchus arvensis	Wet places; sandy cliffs at the Bay	No change	Quite common in the village on the sandy banks of the two streams
Vaccinium oxycoccus	-	Recorded by Mawby in 1964; see text	-
Calluna vulgaris	Surprisingly scarce; plants very dwarf	At the north end there are several acres of pure Callunetum; elsewhere scarce	Common in sheltered edges of dykes
Erica tetralix	In sheltered spots, not common	No change	In similar areas, usually with the next species
Erica cinerea	Very rare	No change	At least as common, if not more so, than *E. tetralix*

Armeria maritima	Common on rocks and cliffs	No change	Similarly distributed
Primula vulgaris	Everywhere abundant on banks and cliffs	No change	Also abundant
Glaux maritima	On rocky bare patches, cliff tops in the east	Also by the sea at the south, in a gull colony	Not infrequent on the promontory
Anagallis arvensis	Weed in keeper's garden	One plant only, sandy patch below the chapel	-
Anagallis tenella	Widespread, reaching the highest point	Abundant throughout the island on the moors	Abundant on the moors
Centaurium erythraea	Not common; limited to the sandy cliffs in the east	No change	Quite common in the dune machair
Menyanthes trifoliata	-	-	Abundant in the bog
Lycopsis arvensis	On previously cultivated areas; not plentiful	Tolerably frequent in the houses	-
Myosotis caespitosa	In a wet place beside a well in the village	(Well not located)	In the little marsh by the village
Myosotis arvensis	Common enough on waste ground and in the village	No change	Similarly distributed
Myosotis versicolor	Also quite common in previously cultivated areas	No change; commoner than *M. arvensis*	-

SPECIES	MINGULAY 1937	MINGULAY 1964	PABBAY 1964
Veronica persica	Waste ground by the keeper's house	-	-
Veronica arvensis	Mainly on dry sandy banks; not plentiful	Quite common on well drained sandy fields above the storm beach	Not rare on the stable dunes
Euphrasia spp.	*E. brevipila:* common *E. micrantha:* 'recorded'	*E. brevipila:* common, moors and old fields *E. micrantha:* old fields only	*E. brevipila:* common *E. micrantha:* not recorded *E. borealis:* in the field inland of the standing house
Odontites verna	Common enough in wet places around old habitations	-	-
Pedicularis palustris	-	-	Common in the bog
Pedicularis sylvatica	Everywhere abundant	No change	Everywhere on moorland, but replaced by *P. palustris* in the bog
Rhinanthus minor	In old fields	-	Common in the machair to the stable dunes
Pinguicula vulgaris	Common and generally distributed	No change	Common in wet places on the moors

Pinguicula lusitanica	Very rare; one station on the north slope of Hecla	Three plants in one place on MacPhee's Hill	Fairly common in the bog and dykes leading into it; (see text on Pabbay for comments on this species)
Mentha arvensis	Old fields	-	-
Mentha spicata	-	-	Plants in the marsh by the village appear to have been this species
Mentha aquatica	In the marsh by the keeper's house	Still there, but also in other wet parts of the valley	In the marsh by the village, along with *M. spicata*
Lycopus europaeus	Common in, but restricted to, the marsh by the keeper's house	No change	-
Prunella vulgaris	Common	Only found in sandy fields near the village	Common on the stable dunes especially near the promontory
Thymus drucei	(Common)	Abundant all over the island; one of the commonest plants	Abundant
Galeopsis tetrahit	In the keeper's garden	-	-
Carex pulicaris	Common on heaths, grassy ledges, etc	Also on the edge of marshes in the valley	Common enough on the moors, and particularly so in the bog

SPECIES	MINGULAY 1937	MINGULAY1964	PABBAY 1964
Carex arenaria	On the dunes	-	Collected, but locality not recorded
Carex otrubae	-	-	Common in sandy ditches around the bay
Carex nigra	Common in wet places	No change	-
Carex flacca	Common	Commoner than *C. nigra*	-
Carex pilulifera	-	-	Collected, but locality not recorded
Carex panicea	-	Common in wet places	Common in wet places, especially in the bog
Carex binervis	Not uncommon on sheltered banks on the moors	-	-
Carex distans	Collected; exact locality not obtained	-	-
Carex serotina	Common in stony areas	-	-
Carex demissa	-	Common in damp places in the valley, scarcer elsewhere	Not uncommon in the village and in the central valley

Carex laevigata	-	-	Uncommon; found on the village side of the central valley
Carex echinata	Very common on damp moorland	No change	Very common, especially around the bog
Gramineae:	It was not possible to devote enough time to this group to make a list worth while. The most important grasses have been mentioned in the text.		
Juniperus communis	-	-	Ssp. *nana*; quite common on the south cliff and the high exposed area inland of it
Ophioglossum vulgatum	Common in some old cultivated areas	No change	Found in well-cropped turf in the village and near the landing place
Narthecium ossifragum	(Common)	Abundant on the moors	Common in wet patches throughout the moors
Juncus squarrosus	Restricted to the north slope of Hecla	Collected, but locality not recorded	Collected, but locality not recorded
Juncus effusus	Common in wet places	No change; the commonest *Juncus*	Common in wet places
Juncus acutiflorus	-	-	Common in brackish rock pools in the tern colony
Juncus articulatus	Quite common	(Not recorded; possibly overlooked)	Found in one of the dykes leading out of the central valley

SPECIES	MINGULAY 1937	MINGULAY 1964	PABBAY 1964
Juncus bulbosus	Frequent in damp stony places on the moors	No change	Similarly distributed
Luzula sylvatica	Rare and local: on the grassy slope leading down to the cliffs in the west; sandy cliffs in the Bay	Still in the west, where locally abundant when ungrazed; not found in the Bay. (Absent in 1979, and replaced by *Vaccinium vitis-idaea*; see text)	-
Luzula campestris	Occurs occasionally in old pastures	This and the next species common throughout the island	Common throughout the island
Luzula multiflora	Also occurs occasionally on dry moorland	Common and generally distributed	Generally throughout the island
Potamogeton spp.	*P. polygonifolius* was common in streamlets, peaty pools, etc	No attempt was made to identify the abundant *Potamogeton* to species	No attempt was made to identify the abundant *Potamogeton* to species
Eriophorum angustifolium	Common on wet moorland and around peaty pools	No change	Similarly distributed
Eleocharis palustris	Common in streamlets	No change	Common in streamlets, especially in village
Scirpus caespitosus	Abundant on the moors	No change	Common on moorland
Scirpus fluitans	Only observed in the streamlet running past the keeper's house	Also elsewhere in the valley, in streams	Found in the two main streams, above the village

Scirpus maritimus	-	-	Found in sandy ditches near village and landing place
Schoenus nigricans	Common, but local, on rocky places	No change	Unaccountably completely absent from this island
Lamium spp.	*L. moluccellifolium*: In the keeper's garden	Two plants found in the village were in several ways intermediate between *L. moluccellifolium* and *L. purpureum*, and did not fit *L. hybridum* either	-
Plantago major	On waste ground in the vicinity of old house	In one small patch on the track from the landing place to the village	-
Plantago lanceolata	Common on the cliffs and in old fields	No change	Common in similar places
Plantago maritima	Generally distributed, but most abundant on the cliffs. In the west occur very dwarf specimens, which form a close turf on the cliff top	No change. The different ecotypes are very well represented	Common all round the coast of the island
Plantago coronopus	Also common the rocks and cliffs	No change	Similarly distributed
Littorella uniflora	Common on the margins of rocky and peaty pools	No change	Very abundant, forming an underwater turf in semi-permanent pools on the very exposed summit of island. Also common elsewhere

SPECIES	MINGULAY 1937	MINGULAY 1964	PABBAY 1964
Chenopodium album	On waste places near the village	Only on the cliffs and flat top of Dun Mingulay	A very few red plants just above the tideline of the beach
Polygonum aviculare	In keeper's garden	-	-
Polygonum persicaria	Occasional in old fields	-	-
Oxyria digyna	Rare; on the cliffs at the north of Bay Sletta	Collected somewhere in the north, but locality lost	Recorded by Heslop-Harrison (1941) in "gorge west of Bagh Ban"
Rumex obtusifolius	Waste ground by the keeper's house	-	-
Rumex crispus	Usually confined to the cliffs	No change	Common on the cliffs
Rumex acetosa	Common enough in old fields	No change	Fairly common around the village and in the dunes
Rumex acetosella	Also in old pastures	Commoner than *R. acetosa*	- (possibly overlooked)
Euphorbia helioscopia	In the keeper's garden	-	-

Urtica dioica	Everywhere near old habitations	No change; even the very old houses at the south end still have patches of nettles	Very common in the ruined houses
Urtica urens	Common as a weed of cultivation	None found in spite of careful searching	-
Salix aurita	Rare and confined to sheltered areas	Only found on the 'ferny cliff' and nearby in north-east, where it is common	A cliff on south side of the central valley was a jungle of this species; also found in other sheltered areas
Salix repens	Much more common than *S. aurita*. General all over the island. Also one plant of *S. aurita* X *S. repens*	No change	Very common, creeping all over the island
Populus tremula	Confined to the sandy cliffs at the south end of the Bay	No change (see text on Mingulay for comment)	-
Triglochin palustris	Not uncommon in wet places beside streamlets	No change	Only found in the bog, where it was common
Triglochin maritima	Rare; in a marsh at the Bay	Two plants in a marshy field in the valley	-
Dactylorhiza incarnata	Very rare, in the marsh by the keeper's house	Confined to this marsh and the marsh by the landing place	In the marsh by the old village

SPECIES	MINGULAY 1937	MINGULAY 1964	PABBAY 1964
Dactylorhiza purpurella	Also in the marsh by the keeper's house	Some leaves were found, probably of this species, in the same marsh. (Common in 1979)	-
Dactylorhiza maculata (= *ericetorum*)	Widespread on the moors	Abundant throughout the island, except the dunes and old fields. (In 1979 *D. fuchsii* was common)	Abundant throughout, again excepting the dunes
Iris pseudacorus	Quite common in marshy old fields	No change	Common in the village marsh and along the streams
Scilla verna	Generally distributed all over the island	No change	Throughout the island
Osmunda regalis	A few dwarf plants, all but one in the southernmost stream in the valley; the other on a seacliff in the south-east	The stream had nine plants. The species was common on the 'ferny cliff' in the north-east, some plants reaching three feet in height	A few plants under rocks on the bank of one stream draining the central valley
Pteridium aquilinum	Confined to the dunes	Abundant and spreading on the north side of the Bay in sandy areas. Sparsely all along the north-east coast, and abundant on the 'ferny cliff'	Only on the 'Willow cliff' in the central valley

Asplenium marinum	Abundant on the cliffs	Although common, hardly 'abundant' anywhere on the island	Common on the seacliffs
Athyrium filix-femina	-	Not uncommon along streams and in sheltered corners; very abundant on the 'ferny cliff', with plants up to two feet high	Common in the sheltered dykes
Dryopteris filix-mas	-	-	Seven plants in the dyke leading south-west out of the central valley
Dryopteris borreri	-	One plant in a ruined house in the village	-
Dryopteris dilatata	-	Common in sheep hollows in the Callunetum at the north end and also on the 'ferny cliff'	Only found on the 'Willow cliff'
Blechnum spicant	Fairly common on sides of banks and dry places on the moorland	No change. Particularly common in sheep hollows in the Callunetum at the north end	Common on sheltered banks
Polypodium vulgare	Very rare; one station only	-	One place only; a few plants on the wall of the dyke leading from the valley to the village

SPECIES	MINGULAY 1937	MINGULAY 1964	PABBAY 1964
Equisetum arvense	-	Common in sandy streams, and in the wetter parts of the old cultivated areas	Very common on the sandy banks of the two streams in the village; also, but rare, in the central valley
Equisetum sylvaticum	A few plants on the 'Aspen cliff'	-	-
Equisetum palustre	Common enough in wet sandy situations near the old village	(For a comment on this species and *E. arvense*, see the beginning of the Systematic List)	-
Selaginella selaginoides	Quite common on banks of ditches, streamlets, and wet bare soil	Only found in old cultivated fields in the valley	-
Lycopodium selago	-	One plant, on the north-west slope of Carnan	-

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THE 1986 CENSUS OF GANNETS ON AILSA CRAIG

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The 1986 census of the Ailsa Craig colony of Gannets *Sula bassana* again took the form of a one-day census made from the sea in early May, with the usual check counts of selected control areas later in the year.

Present Population

The detailed counts for 1986 are given in Table 1, along with the comparative counts for the previous three years. As before, all are direct counts through binoculars of occupied nests, and all figures comprise the mean of several counts of each cliff-section, made at different times throughout the same day from the same counting-stations. Only occupied nests are counted; all Gannets not occupying nests are ignored. Control counts mmade later in the year (all of which again confirmed the figures of the one-day census in early May) are used only as checks, and are not included in the official census.

No further population 'crashes' have taken place since 1975, and the colony has continued to increase by an average of just under 1,000 nests a year, although there may now be some slight indication that the rate of increase is slowing down; the increase reported for 1985 was 814 nests, and this year (1986) the increase is only 231 nests. Nevertheless, the 1986 count of 23,042 occupied nests is again the highest population of Gannets ever to have been recorded for Ailsa.

Previous Work

Direct counts of all occupied nests have now been carried out at the Ailsa Craig Gannet colony for nearly half a century. This work commenced in 1936, with a pioneer count by H.G. Vevers and James Fisher, and apart from a slight gap during the war years, when only curtailed counts and estimates of population could be used, they have continued without a break ever since.

As previously reported, by arrangement with the Editors the results of the annual Ailsa Craig Gannet census are now being published regularly in the *Scottish Naturalist,* but the results of the previous annual census work appeared in various publications, in particular for some twenty years in the series

Table 1

Counts of Gannet Nests on Ailsa Craig
1983 - 1986

Total for each cliff section represents the mean of several separate counts

Colony	1983	1984	1985	1986
Sliddery	299	348	371	390
Sliddery, Top Ridge	483	506	548	538
North of the Slunk	417	501	536	549
Foot of the Slunk	556	597	629	638
Above Ashydoo	244	287	299	307
Balvaar	1013	1037	1083	1098
Below Balvaar	283	308	306	322
Balvaar, Top Ridge	387	401	449	473
Balvaar to Cairn	544	549	562	589
The Cairn	2681	2703	2749	2783
Cairn to Mare	672	688	726	731
Barrheads	2301	2457	2498	2523
Above Black Holes	388	413	452	439
Mare	4101	4306	4301	4318
Mare, Lower Ledge	197	188	191	190
Above Bed o' Grass	288	303	322	341
Mare-Stranny Point, S1	568	596	593	602
Mare-Stranny Point, S2	592	614	648	639
Mare-Stranny Point, S3	787	841	893	931
Mare-Stranny Point, S4	889	942	985	997
Stranny Point, South Side	51	48	50	52
Main Craigs, Main Part	1281	1303	1396	1403
Main Craigs, Top	1464	1499	1573	1555
Main Craigs, East	428	426	481	478
Main Craigs, East Top	96	89	111	103
Main Craigs, Far East	-	-	-	-
Main Craigs, Far East Top	62	47	59	53
Grand Total:	21072	21997	22811	23042

of *Clyde Seabird Reports* largely created for the Ailsa Gannet census by the Renfrewshire Natural History Society. A comprehensive bibliography of all past census work was given in Gibson (1983), and for ease of future reference it seems useful to repeat this bibliography and to bring it up to date. The published sources of all past census work are therefore listed below in chronological order, along with a few other items which have a direct bearing on the Ailsa Gannet colony.

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SOME OBSERVATIONS ON THE ECOLOGY OF COASTAL OTTERS IN WESTERN SCOTLAND

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Introduction

The majority of studies of the Otter *Lutra lutra* L. have concentrated on the endangered riverine populations, and so far the relatively common and more easily studied coastal Otters have received surprisingly little attention (Herfst 1984, Chanin 1985, Mason and Macdonald 1986). Particularly high densities occur on the north-western coasts and islands of Scotland, and the investigations carried out during this present study from May 1977 to May 1978 covered holt distribution and use, foraging behaviour, and a series of spraint (faecal) analyses.

Study Methods

The main study area was the 2,800 hectare Drimnin Estate on the Morvern peninsula, Argyll, consisting of heather moorland rising to 367 metres, interspersed with boggy *Molinia-Trichophorum* grassland, bracken, and with pockets of birch woodland along the coastal cliffs and valleys. The underlying basalt, with some psammitic granulite, was exposed and broken up into large blocks and boulder fields along the coast, thus providing many ideal holt and lying-up sites for Otters. Limited observations were also made on the neighbouring Barr Forest shoreline, and on the Ardnish peninsula near Lochailort, Inverness-shire, previously studied by Kruuk and Hewson (1978).

Major holts were mapped, and spraints at five Drimnin holts (A - E in Tables 1 and 2), selected to include both shallow and deep water fishing areas, were analysed to demonstrate gross composition and trends in the main food categories. Sprainting sites were cleared systematically at monthly intervals, so that only fresh samples were present at the subsequent monthly visits, and spraints were analysed in the field. Percentage by volume was deemed to be the simplest and most realistic investigation method, since a large proportion of spraints consisted exclusively of only one food category, and the small amount of carapace ingested in broaching a crab was probably comparable to the relatively

large amount of bone and small volume of meat eaten from typical small fish prey. Thus a few fish vertebrae in a 'crab' spraint would rank equally, if considered by frequency of occurrence, although relative frequency of occurrence, or percentage weight with correction factors in conjunction with captive trials have also been employed in previous studies (Erlinge 1968b; King 1977; Jenkins, Walker and McCowan 1979; Watson 1978).

Population Biology

Population structure was based on a series of major holts, usually within 50 m of the shore, although secondary temporary lying-up places amongst boulder fields and under overhanging ledges were used elsewhere in the home range, and were sometimes shared with Foxes *Vulpes vulpes* or Badgers *Meles meles*, e.g. at Ardnish. Characteristic features of major holts were well worn runways, fresh spraint on tumps of long standing, a pool, and probable use from time to time for cub rearing. A pool well above high tide mark was particularly diagnostic, being present at all twenty major holts (with the exception of one doubtful one) in the three study areas, and usually having conspicuous fresh green vegetation within the pool's splash zone. On one occasion, cubs were seen using a pool after emerging from the sea, and, as was suggested by Elmhirst (1938), the pools are probably used both as a source of fresh drinking water and to wash salt from the fur.

Maximal deposition of spraints at Drimnin occurred in the immediate vicinity of major holts, so that spraint and the associated anal gland 'white jelly', which has been shown electrophoretically to be chemically distinctive individually (R. Harper, pers. comm.), were therefore placed in the most advantageous positions to repel territorial intruders or to greet transients approaching from the likeliest route via the sea (Gorman 1980, Kruuk and Hewson 1978); this is in marked contrast to the riverine situation, where maximal marking occurs appropriately in the overlap zone between territories (Erlinge 1968a).

At Drimnin, seventeen major holts were found along some sixteen km of involuted coastline, with an average holt separation of 0.8 km (range 0.1 to 2.3 km). The slightly lower density found for Ardnish, with an average separation of 1.2 km (Kruuk and Hewson 1978), was possibly due to the longer stretches of unfavourable sheer coast. These major holts all showed signs of continuous occupation, although there was some evidence of an inverse correlation in the amounts of fresh spraint between certain neighbouring holts, thus suggesting

that more than one 'major' holt could belong to one home range. Apart from females with cubs, Otters were almost invariably encountered as solitary individuals within some 500 m of known holts, perhaps indicating a density comparable to Shetland, where Watson (1978) found a home range of 2.5 km, with one male range overlapping two female ranges, and a density of one Otter per 1-2 km of coast. This contrasts with optimal Swedish river-lake systems (Erlinge 1967a, 1968a), where one male covered up to three female ranges, but populations were sparser, with home ranges of 7 to 15 km in diameter according to sex (F/M), and densities of one Otter per 2-5 km; in Britain, a density of one Otter per 10 km of river has been suggested as the norm (King 1977).

No fixed breeding season is apparent in much of the southern range of the Otter, but northern populations seem to exhibit a rutting season from late winter to early spring (King 1977), and this may also occur in north-west Scotland, since at Drimnin two cubs seen at different times with one or both parents were believed to comprise two separate families, and were estimated to have been born in the spring (March-May), while two Otters seen at the end of November were believed to be a courting pair (R. Hewson, pers. comm.). Watson (1978) recorded four June litters from Shetland, and Elmhirst (1938) also suggested an early summer cubbing period.

Foraging Behaviour

Human interference was relatively unimportant at Drimnin, and Otters were seen fishing at any time of the day. The state of the tide was probably a more critical factor, with nine out of thirteen observations of foraging Otters occurring within two hours of low tide. Seven of these occurred during the period of increase, when the depth of water above the optimal weed-zone fishing areas would be shallowest, thus reducing unproductive diving time to a minimum, and where the returning tide would be most likely to bring in or disturb the small-medium sized benthic prey. Particularly favoured fishing areas comprised inlets and channels between offshore islets where such ebb and flow disturbances were greatly accentuated (Kruuk and Hewson 1978, Watson 1978).

Surfacing Otters were seen to crunch small food items after approximately one in every three dives, and these were probably often amphipod crustaceans, a common item in spraint at the holt nearest to where most observations of foraging Otters were made. More rarely, crab, or fish some 15 cm long, were seen to be taken ashore before being eaten head first, and the frequent occurrence of gutted crabs, and once a 30 cm

Dogfish *Scyliorhinus caniculus*, on rocks near to the holts, suggested that larger prey is eaten ashore, a conclusion substantiated by other workers (Elmhirst 1938, Rowbottom 1970). Otter fishing trips were seen to last for up to an hour and a quarter, a full meal presumably being acquired within this period, so that even if several meals a day were necessary, the daily foraging time was relatively short in this optimal habitat with abundant food resources.

Diet

From spraint analysis, fish comprised over 67% of the total diet from December 1977 to May 1978 (see Table 1), and although not analysed in detail from May to November 1977, fish appeared to increase in importance at the expense of the less available crustaceans during the winter months. Elsewhere, in various mainly freshwater habitat studies of both Eurasian and Canadian Otters (Chanin 1985; King 1977; Mason and Macdonald 1980, 1986), a similarly high preponderance of fish was noted, along with local and seasonal utilisation, dependent largely on availability and vulnerability, of both crustaceans (mainly Crayfish *Astacus fluviatilis*) and amphibians (mainly anurans).

The importance of decapod crustaceans in the diet of coastal Otters was noted by Elmhirst (1938), Rowbottom (1969, 1970) and Watson (1978), inter-tidal or shallow-water species taken including the Common Crab *Carcinus maenas*, Edible Crab *Cancer pagurus* and Velvet Crab *Liocarcinus puber*, while reports of Otters drowned in lobster pots are not uncommon. In the tropics, freshwater and land crabs are of major importance in the diet of various species of Otter (*Aonyx*, *Amblonyx*), and are also important to comparable animals, such as Marsh Mongoose *Atilax paludinosus*, Crab-eating Mongoose *Herpestes urva*, Otter Civet *Cynogale bennettii*, and Giant Otter Shrew *Potamogale velox* (Nowak and Paradiso 1983). Smaller crustaceans taken by coastal Otters included shrimps (Amphipods) with a few Isopods, some gleaned along the tide lines (Elmhirst 1938), but most usually caught in the shallow water weed zone.

Crustaceans were relatively more important in the warmer months (see Table 1), and at certain holts according to the availability of crabs, and especially of shrimps (Table 2). Holts D and E overlooked open sea with direct access to deep water via steep rock or rapidly shelving shingle beach, whereas holts A, B and C had easy access to gradually shelving mud-shingle beaches with low-tide exposure of the weed zone, and overlooked the relatively sheltered bays between Carna and Oronsay Islands and the mainland; these bays were also visited by commercial prawn fishermen.

Table 1

Otter Spraint Analysis at Drimnin, 1977-78

Percentage by volume

Month	Holt	Fish	Crust -acean	Moll -usc	Echino -derm	Anuran	Bird	Mammal	N
Dec-Jan	A-E	83.4	14.5	0.7	-	-	-	1.4	138
Dec-Jan	F-J	78.5	21.5	trace	trace	-	-	-	132
February	A-E	63.5	31.7	1.1	0.4	-	1.1	2.2	175
March	A-E	59.8	27.9	0.2	0.2	11.9	-	-	184
April	A-E	66.5	32.5	0.5	-	-	-	0.5	178
Feb-Apr	F-G	66.3	30.1	0.7	-	2.9	-	-	136
May	A-E	64.3	35.4	0.3	-	-	-	-	274
Total	All	67.9	28.8	0.5	0.1	2.1	0.1	0.5	1217

N = Number of spraints analysed.

Table 2

Otter Spraint Analysis at Drimnin, 1977-78

Percentage occurrence of crustaceans in spraint at the five main holts

Holt	A	B	C	D	E
Crab	24.5	19.2	15.2	10.6	8.5
Shrimp	6.0	5.2	5.1	3.2	2.5

Coastal Otters often travel long distances inland, usually via streams, possibly to avoid winter storms, in quest of mates or territory, or to exploit sporadic food resources, such as the July Salmon *Salmo salar* and Sea Trout *Salmo trutta* 'runs' or the much relished Eel *Anguilla anguilla* (Elmhirst 1938, Rowbottom 1970, Watson 1978). The high incidence of anurans in the diet, at all the main holts studied, coincided with the late February to early March spawning period of both Frogs *Rana temporaria* and Toads *Bufo bufo* in pools and bogs on the higher ground, and was probably underestimated since much additional spraint, composed largely of anuran bones, was found up to a kilometre from the sea, both at Drimnin and at Ardnish. This temporarily abundant prey was also being exploited by Herons *Ardea cinerea*, Badgers and Foxes; Fox scat analysis showed that anuran prey comprised over 2% by volume of the Fox diet at this time. Anurans were probably taken at other times, although a spring peak and occurrence during the winter hibernation period was also noted in freshwater studies elsewhere (Erlinge 1967b, Fairley 1972, Hewson 1973, Stephens 1957, Webb 1975).

Echinoderms (Sea Urchins) and molluscs appeared to be taken very infrequently. Some of the small snails were probably ingested accidentally from the gut of fish prey, although some of the bivalves were taken deliberately (e.g. Razor Shell *Ensis* sp.), and Elmhirst (1938) recorded Mussel *Mytilus edulis* as present occasionally. Molluscs, insects and worms also comprised only minor items in previous studies (Fairley 1972, King 1977).

Bird remains were noted in only two samples, from one holt; possibly Hooded Crow *Corvus corone* carrion. In other studies, bird was usually only a minor element, although occasionally was of greater significance (Hewson 1973) and even comprised birds as large as swan *Cygnus* spp. and Heron.

Mammal fur was noted in only seven samples, and included Field Vole *Microtus agrestis*, deer, and sheep wool. Otters are said to avoid carrion, but they may utilise Salmon carrion (Cuthbert 1973) or may cache large fish as an anti-gull device (Rowbottom 1969) and, like most predators under conditions of food shortage, will occasionally feed on mammalian carcases encountered during excursions overland; e.g. Cuthbert (1973) noted wool in spraints on the river Tweed, and Otter spraint was seen on several occasions beside sheep carcases at Drimnin. Otters have often been accused of killing lambs or even yearling adult sheep, both in Britain and on the Continent, but authentic cases are few (Harris 1968, Hewson pers. com., Stephens 1957), and no evidence of this was seen in the present study. In the various studies carried out elsewhere, only

occasionally has mammal prey been of other than minor importance (e.g. Simms 1971).

Summary

The mainly marine fish/crustacean diet of west coast Otters was supplemented in the spring by forays inland to anuran spawning grounds. Some observations on foraging behaviour and population biology are discussed in relation to holt distribution.

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